

MEMORANDUM ON THE PREVENTION OF LEPROSY BY SEGREGATION OF THE AFFECTED.

The following brief Memoir is the third I have compiled for submission to the authorities of British India; and, like its first predecessor, it is based upon unique experience acquired through the enlightened proceedings of the Government of Norway.

By the kindness of Dr. G. A. Hansen, the able Superintendent of the Leper Department, I am enabled to offer the latest known statistical data; and by the courtesy of the Director of the Civil Medical Service in Norway, I have been supplied with a series of reports in confirmation of those described in my earliest communication to the India Office, 1873. Since 1875 some changes in these have been made; and in future only quinquennial reports will be issued, the next being due in 1885.

Considering afresh the information thus accruing, I propose, in the interests of India, to discuss: (1) the present state of the leper question in Norway; (2) the probable explanation of amendments noted; and, (3) hygienic measures suitable for India. An illustrated note on the pathology of leprosy is also subjoined.

PART I.

PRESENT STATE OF THE LEPROS QUESTION IN NORWAY.

The methodical isolation of lepers has, during the past 25 years, been carried on with unremitting effort; the result being a decided diminution of the sick throughout this period. On initiation of the restrictive measures sanctioned, it was not anticipated that marked effects would quickly follow; and hence no dissatisfaction is expressed at the moderate and gradual amendment which has ensued. Recognizing from the first the incurability of leprosy, the State limited its attempts to opposing the hitherto continuous reproduction of disease; and such anticipatory sphere of action admits only of radical rather than slow achievements. How much longer these somewhat costly measures may have to be maintained cannot yet be said; but it has been learnt that restrictive means ought, if possible, to be extended, and could be remitted only at imminent risk of renewed spreading of disease.

Registration of the affected being an essential preliminary, I note that properly it includes, besides an enumeration of the lepers, a due record of their history and movements. In Norway the district medical men have always been aided, under express injunction, by "all clerical and secular officials and functionaries" of Government; and the peasantry not opposing, it might be expected that the yearly register would be fairly exact. In this matter, however, precision is everything; and it has long been apparent that so simple a result as a strictly accurate list of lepers is hard to be obtained. Thus the malady in question begins obscurely and proceeds slowly; it seldom early disables; being at first set down as a blotch, it is disregarded by patients and their friends; and since, in addition, many bad subjects purposely evade registration, it results that of the "fresh additions" brought to light year by year only $\frac{1}{2}$ are "new cases" of quite recent origin, whilst $\frac{1}{2}$ are entered as "overlooked" cases dating back two, three or several years to the beginning of illness. As to the possible number of such latent *residua*, Dr. Löberg, in 1870, liberally estimated them at 300 (*vide* my First Report, p. 17); whereas by the adjusted tables of 1880 it appears there must have been then at least 500 unrecognized or undetected lepers in the country, or one-quarter more in excess of the 2,030 actually known. This datum illustrates the difficulties of registration which are met with in Norway, and which also, I may add, obtain in Western India; since *e.g.*, instead of the Census (1871) number of 153, I found there were at least 472 lepers existing in Kathiawar during 1876, most of whom had of course been overlooked (*vide* Kathiawar Report,

p. 65). The Norse Tables show separately the number of asylum inmates (duly known and named) and of home-dwelling sick (only approximately ascertained): these combined numbers furnishing a plain total, which, for convenience, is added in column 10 of the statement below. Such ordinary enumeration is not, however, of more than very limited value; and in 1870 the tables supplied an adjusted list of lepers, combining in addition the numbers who, to judge from their aspect and ascertained duration of illness, must for varying periods have been all along living unregistered in the country districts.

Such numbers are still considerable—*a. g.*, on comparing the list below, column 3, with a later one for 1881 I have been privately favored with, it appears that during this last year alone no fewer than 74 “overlooked” cases were found which had to be incorporated with the figures in the preceding year’s list of dates corresponding with the beginning of illness as follows:—17 of 2 years’ duration, 18 of 3 years’, 10 of 4 years’, 2 of 5 years’, 4 of 6 years’, 8 of 7 years’, 3 of 8 years’, 1 of 9 years’, 1 of 10 years’, and so on; 4 being referred back so far as 25 years. Besides these, there were 16 strictly “new” cases brought to light in 1881: the total “fresh additions” (as I here use the term) in that year amounting, therefore, to 90. The latest issued table in the amended form is the one for 1880, which is copied below in columns 1 to 9 inclusive:—

Tabular Statement of the number and movements of all the Lepers known in Norway during the years 1856—1880 inclusive.

Year.	Total at beginning of year.	New cases.	Diminution both in and outside asylums.			Remaining at end of year.		Total at end of year.	Total at end of year, by old enumeration.
			Died.	Discharged.	Cured.	At home.	In asylums.		
1	2	3	4	5	6	7	8	9	10
1856	2,523	235	2,503	2,113
1857	2,367	427	2,704	2,060
1858	2,323	475	2,798	2,083
1859	2,296	523	2,819	2,035
1860	2,242	539	2,781	2,068
1861	2,060	711	2,771	2,096
1862	2,046	698	2,744	2,119
1863	1,979	749	2,728	2,162
1864	1,943	781	2,729	2,182
1865	1,938	772	2,710	2,186
1866	1,900	785	2,704	2,126
1867	1,898	787	2,685	2,157
1868	1,888	798	2,676	2,119
1869	1,832	787	2,619	2,104
1870	1,769	764	2,553	2,065
1871	1,682	747	2,429	1,987
1872	1,695	768	2,356	1,943
1873	1,593	670	2,263	1,874
1874	1,570	617	2,187	1,832
1875	1,470	623	2,093	1,771
1876	1,395	613	2,008	1,731
1877	1,294	620	1,923	1,704
1878	1,237	618	1,855	1,691
1879	1,115	602	1,717	1,643
1880	965	617	1,582	1,606

Remarks on the above Table.—The headings of the several columns mostly explain themselves. Only the figures in columns 4 (deaths), 5 and 6 (discharged and cured), and in column 8 (asylum inmates), are certain and fixed; all the other numbers being approximate, are liable to rectification in course of time.

A.—Decline of Leprosy.

This fundamental point is capable of being established in various ways. Thus, according to the enumeration in column 10, at the end of 1856 there were known 2,113 lepers, and in 1880 only 1,606, showing a diminution of 507 in the course of 25 years. But if (as in the adjusted lists) all overlooked cases whose duration dated two or more years back be added in their due place, there must have been at least 2,863 lepers (vide column 9) in 1856; and in the succeeding years a corresponding number gradually declining until the latest, when the same annual enumeration is found in both columns—the small difference here of 24 referring to lepers sent to the asylums without ever being registered in the country districts. According to the new reckoning, therefore, the total decline of lepers amounts to 1,281; but this estimate probably is nearly as excessive as the other was defective, because no allowance is made for cases still remaining undetected in 1880. What the precise decline of leprosy has been cannot indeed yet be learnt, and strictly not until the demise of every leper in the country will it be ascertainable, this drawback being inherent to the exacter methods of registration. Probably the diminution has amounted to near 1,000, or about one-third of the total known in 1856; and this would be a very notable result to attain in so short a time.

Confirmation of the opinion now expressed is the following:—According to the above tabular statement the total of new cases (column 3) has been 3,965, while the total outgoings (columns 4, 5 and 6) have amounted to 5,246, leaving a deficiency of 1,281, which being far too considerable to be attributed to oversight becomes explicable only on the inference of a real decline of disease. Again, some details of column 3 not here shown are, I find, very significant; thus, in former years there were about 250 “fresh additions” annually registered, now only about 150; of these upwards of 100 used to be of quite recent origin, whilst now only 25 in the mean are “new” cases. And although successive years might vary, yet registration continuing at least as efficient as ever, this datum becomes conclusive of real amendment, and that in the best possible direction. So also the following:—The proportion of “new cases” to total “fresh additions” used to be 40 per cent, the remainder being made up of “overlooked” cases of more or less prolonged duration, whereas now it is only 16 per cent: that some overlooked cases will hereafter come to light is inevitable, but it is of good augury that these already form the very large majority of fresh additions, the strictly new cases becoming both relatively and absolutely smaller by degrees, and indubitably less.

Lastly, some indirect evidence may be adduced. Relying on the immutable figures in column 4, I note that the mean annual deaths of lepers is now 180 instead of 244 as formerly; whence, on the presumption that the leprous disease has remained unchanged, it becomes evident there are now fewer subjects affected by it. According to column 10, the annual death-rate has declined from 14·2 per cent in 1857 to 9·3 per cent in 1880; and there being no proof of belief in Norway (so far as I am aware) that the pest is in character so much less severe or fatal now than formerly as these two ratios would imply, it follows that in earlier years there were more lepers living than are entered in column 10, those entered in the amended column 9, with a nearly uniform death-rate throughout of 9 per cent, giving manifestly the correcter estimate. Supposing, therefore, leprosy to be in Norway the same scourge now as ever, on this basis I reckon there may have taken place a diminution of about 30 per cent in the total number of its victims.

The above data, in general, concur; and there being none to my knowledge adverse, the point in question must be regarded as affirmed.

B.—Movements amongst the Leper Community: Columns 4, 5 and 6.

Column 4. Mortality.—For the whole 25 years the mean annual deaths are 202; of late about 160 only, of which 87 in asylums and 73 in the districts. Formerly, when the afflicted were more numerous, the deaths also were commoner and rather most frequent in the districts. The mean death-rate of leprosy in Norway

8-9 per cent per annum: amongst the incarcerated (who include the worst and most advanced cases) the mean death-rate rises to 9-14 per cent per annum, whilst among home-dwelling sick it may be estimated at 5-7 per cent per annum. For many years past there has not occurred any marked or progressive change in the mean death rates; thus, in 1852 that of asylums was 13 per cent and of districts under 6 per cent, whilst in 1880 the former was 11·3 per cent and the latter also under 6 per cent. The greater range among asylum inmates than outside these institutions is owing, as appears, to occasional brief outbreaks of local sickness (see below).

Column 5.—In the mean about 10 subjects yearly leave the asylums uncured, or outside become lost sight of, equal to about 1 per cent of the totals known. In Norway, as elsewhere, lepers are subject to home-yearning, secretiveness and impatience of control; but there are fewer facilities for evasion or decamping here than would be in India.

Column 6, The Healed.—The Norwegian authorities have always candidly recognized and published a paucity of results under this heading, which of itself betokens the present hopelessness of a cure for leprosy, and the need of sole reliance on preventive measures for mitigation of this scourge. In the table are entered only 107 as healed, the total annual mean being 4 or 5 cases reported from both districts and asylums, equal to 1·63 per cent of grand total of lepers 6,518, or yearly less than 1 per cent. Nevertheless, the systematic use of drugs is practised in the asylums, and particularly in Lungegård Hospital under charge of the venerable Dr. Danielssen, where are admitted cases specially adapted for early and energetic treatment. It appears from the reports that most recommended remedies have been fairly tried, yet without any uniformly successful result; and some partial mitigation of suffering is as yet all that drugs can effect. I also note that the detailed tables have a column for cases relapsing into sickness after 'healing'; and from observation everywhere, it is known that the more prominent marks of disease may spontaneously subside, more or less, and remain in a quasi latent state for several months or years. In consequence of this, the term 'cure' may at all times be detected, so that 'cure' becomes a provisional expression. And lastly, I see in these European documents a reflex of Indian experience; in the occasional disappearance of skin-disease termed leprous, but really of a different and more amenable character.

C.—The Isolated and Non-isolated: Columns 7 and 8.

Column 7, Home-dwellers.—Necessarily, from their large numbers, all lepers in the country could not be relegated to asylums; but the aim has been to isolate as many as practicable under existing conditions. The result is, according to the table that the series of district-residents is a steadily diminishing one, now amounting to only 37 per cent of its earliest sum. At successive decennial periods the numbers in column 7 were as follows:—1860, at home 2,242 or about 80 per cent of total lepers then known; in 1870, at home 1,769 equal to about 70 per cent; and in 1880, at their homes 955 or about 61 per cent of all afflicted then known. By the year 1885 it is anticipated that 50 per cent or one-half the entire leper community, will be isolated; and by 1895 it is hoped that 75 per cent may be so separated, leaving only 25 per cent at unrestricted liberty amongst healthy persons. That there really has taken place this most desirable diminution in the number of free home-dwelling sick is shown inferentially by the lessened proportion of deaths therein occurring; thus, whilst during 1860-72 the numbers dying both within and without asylums were nearly identical, during 1870-80 the proportion of asylum-deaths rose to 71·6 per cent and that of district-deaths sank to 28·4 per cent of total deaths. In fact the declining loss of life from leprosy in Norway is due solely to lessening of home mortality; and the smaller this becomes, obviously the better for the common weal.

Column 8, The Immured.—In a population of any size the amount of asylum accommodation must be so limited that only a part of all lepers can be segregated from the sound. In Norway, three large and two smaller institutions—of which three at Bergen and two farther north—comprise the available means of isolation; capacity equal to lodgment of 800 sick: total population of country about 200,000.

total lepers still near 2,000. The minimum of incarcerated was 295 in 1856, the maximum 769 ten years later; and thence a slow decline to 617 in 1880. This decline is not due to lessening of accommodation, but to persistent unwillingness of the peasantry to send in their sick; and I learn it is now contemplated to seek more compulsory legal powers of segregating lepers, if not in the asylums then at their own homes. That a real and continuous progress of isolation has, however, already been effected is evident:—thus, at first in 1856, only about 8 per cent of sick were immured; in 1860, the figures were 539 in 2,781, or 19 per cent; and in 1870, they had risen to 764 in 2,533, equal to 30 per cent. In 1880 the figures were 617 in 1,582, or 39 per cent; but this datum is an uncorrected one, and it may be that the ratio of immured to free has not of late much increased. If this surmise be an correct as it seems there is, I would remark, additional reason to urge isolation at home in aid of the more public means. The numbers yearly admitted into the asylums during the past 20 years has varied from 173 to 112: during the last quinquennium it has been about 125, a minute proportion of these being due to transfers and re-admissions. The outgoing by disease amongst the immured also varies, there occasionally happening brief epidemics of erysipelas, pneumonia or diarrhoea, though such signs of 'hospitalism' are not, I think, commoner in leper asylums than in other collections of sick persons. Further details regarding these institutions will be found in my earlier report; and here I will only add that amongst their inmates there is commonly a slight predominance of women (519 females to 298 males in 1880); whilst outside, men are most numerous—843 males to 763 females in 1880.

PART II.

PROBABLE EXPLANATION OF AMENDMENTS NOTED.

According to the preceding section, in Norway there has of late years occurred a distinct decline in the number of lepers, and this under opposite conditions, namely, on the one hand a continuous production of new cases, and on the other a large ~~offsetting~~ ~~death-rate~~. ~~A third important condition, however, intervenes, and that is, the complete isolation of a large proportion of the affected persons.~~ Other possible agents in the amelioration noted will also be alluded to below.

In limine, I should state that the 'cure' of leprosy by purely medical treatment has not practically contributed anything towards obliteration of the disease. To rely, therefore, for a general amendment upon any of the varied remedial measures often confidently put forward would be to indulge in fallacies hurtful as well as deceptive and to encourage a kind of anticipation hitherto shown by experience to be futile.

Next, that the disease is subsiding from a 'natural' cessation of its growth seems to be disproved by the following considerations:—Supposing no reproduction of the malady, its decline would be much quicker than is now happening; for with a death-rate of 10 per cent per annum, the 2,863 cases alive in 1856 would in the course of 7 years have been reduced about one-half, and at the end of 14 years to about 650, and so on, till, at the end of 25 years, there would remain only about 200 lepers, whose mean age would not be less than 60 years—assuming the mean age at starting to be 35 years. In reality the rate of decline would be more rapid than this, because the death-rate rapidly rises with advancing years: thus the Norse tables show that not less than 40 per cent of all lepers die between 31 and 60 years of age, 17·3 per cent dying earlier at 21—30 years. But the same tables prove that there has not occurred any such rapid diminution of the pest; there now being known at least nine times as many lepers living as should be, on the hypothesis of a direct dying out of disease in the country. Moreover, that leprosy in Norway really displays any natural tendency to subside is disproved by the researches of Dr. Hansen (Report of 1880, pp. 17-8), who shows that in most of the affected districts the death-rate is not by any means in excess of the increase-rate; the very reverse, indeed, being the fact—which indicates that the natural tendency of leprosy is more or less to extend.

Thirdly, the decline of disease might be attributed to mitigation of various harmful agencies popularly associated with its origin: e. g., to the lessened use of a fish diet, to a less harsh and insanitary mode of life, or to the extended cultivation of an originally noxious soil, or to some climatic improvement. But, whilst the coast-dwelling peasantry of Norway, in comparison with other (not all) countries of Europe, have admittedly long dwelt in a backward hygienic condition, living much on fish and potatoes, intermarrying freely, and being subject to overcrowding during their long winters; still on the other hand, it is notorious that they are an unusually well developed and long-lived race: and besides, individual lepers are, as often as others, even robust people. Generalized statements, therefore, not sufficing to uphold the view suggested it ought to be shown when and where hygienic improvements have had an exclusive connection with the decline of leprosy inside limited areas, often placed wide apart; as well as with its diminution during short periods of time. Evidence of this kind, however, I have not met with; and on further comparing the conditions under which leprosy now flourishes in other parts of the globe, I fail to find any cogent evidence that this disease is essentially dependent upon unhygienic states, resembling those long prevalent in Norway. Experience here (as elsewhere), rather points to its dependence on personal conditions; for where most abundant the disease is there most irregularly distributed: thus, amidst healthy spots in Norway there are adjoining ecclesiastical areas with about 2,000 people (all living under closely similar states and habits), where the number of lepers was known to vary as much as 80, 30 and 8—these figures being now reduced respectively to 17, 15 and 0, without any notable change in population: and to attribute such striking local variations solely to widely operating agency seems to me both rash and, in the presence of a closer acting influence, needless. Nor to my mind, any more satisfactory is the assumption of some vague individual predisposition amongst the affected.

In his report for 1876, Dr. Hansen discusses this subject in the only suitable way, namely, by instance to examples; he remarks (p. 60) that if unhygienic operated as a direct, or (through raising hereditary taint) as an indirect cause of leprosy, there should before the asylums were erected have been proceeding a decided hygienic improvement, the effects of which were manifest just when the practice of isolation began; such improvement also ought to have preceded or attended, at least, the after course of disease; hereditary influence, too, then being checked, as well as the spontaneous appearance of new cases. But of all this there is no evidence, the facts known tending rather to disprove. In more detail, the districts of Tromsø and Trondhjem should present a remarkable picture of hygienic progress; thus, during 1857-60 little or no isolation and an advent of new cases in 1856-60 and 1861-65 almost identical of 352 and 351 respectively—also no sign of hygienic advance; but in 1861-65 there were sent 293 lepers into the asylums, and during the following 5 years the new cases declined by 37—a number almost precisely corresponding to the estimate, which might have been made from the prior rate of increase proportionate to number of home-dwellers. Is it imaginable, here, that any culture-amendment had then suddenly culminated and found expression? Next comes the fact that, in general, leprosy still continues to progress at its former rate; which would show that hygienic changes, even if concurrently made, can have had little or no influence on the progress of the disease. And further, were hygiene (in the ordinary sense of the word) really so operative as is urged, the isolation of lepers must offer scanty promise of good, as not itself materially lessening harmful conditions; but this inference is contrary to other reasonable deductions. Some of the above remarks apply to hereditary influence as a source of leprosy infection; for in not a few examples of local decline of disease submitted to analysis there has been found too prompt and decided an amelioration in families to permit of this slow-acting agency being regarded as mainly influential. And in so far as appears to me, leprosy can be directly mitigated by dietetic, hygienic or climatic influences only to the same extent as, and no further than, the analogous chronic infections of man known as syphilis and tuberculosis.

Lastly, failing other explanation, it may be asked if the decline of leprosy in Norway be not nearly connected with the practice of isolating the sick in the asylums erected for their use. These institutions, I would remark, were originally intended, by segregating apart the more vigorous lepers of both sexes, to aid in checking the propagation of disease through marriage; they were also meant to accommodate the worst cases, or those a burden to their friends; and to a minor extent they were to serve as hospitals for curative treatment. Though founded so far back as 1836 it has only of late become possible to estimate their influence over the general progress of this very chronic pest; and owing to the inevitable obstacles to correct registration alluded to in Part I, the data available for satisfactory analysis are still but limited. Dr. Hansen's observations in his quinquennial reports for 1873 and 1880 may, I think, be regarded as the earliest attempts scientifically made to determine the real effect of the isolation of lepers in a community: his main conclusions are summarised below. I have also considered the recorded opinion of preceding Norse physicians and, on the whole, prefer the later view. In Part I it is shown that leprosy is not declining simply by a process of dying out, but that there is continually taking place a certain reproduction of disease; and it is only when and where this last proceeds at a lesser rate than the death-loss that the pest can be said to be subsiding. A third condition, however, concurs, *viz.*, a contemporary removal from the districts and isolation in asylums of many old and new cases of infection; and the question now arises, how does this isolating process influence the others? or these failing, itself account for the amendment proved in Part I? Within the asylums there occurs a higher death-rate than outside, whilst in them no new cases can arise; on the other hand, in the country districts there obtains a lower death-rate, and here alone do new cases appear. The asylums serve as a means of partially evacuating the infected districts, abstracting particularly the worst examples of disease; and they are not necessarily, it might be said, otherwise concerned in the general progress of disease. But would such assertion be correct? Let it be agreed that to clearly comprehend the course of leprosy, attention must be directed to conditions obtaining in the districts, amongst which the chief one is the number of "new" cases which arise, proportionately to the total of "home-dwelling" sick: for if the accretion-rate of new cases exceed the death-rate of home-dwellers, then disease is on the increase; and vice versa. Now, in his report for 1876, Dr. Hansen shows that up to 1870 in only one easterly district had the death-rate exceeded the production-rate; whilst everywhere else the accretion-rate was highest. There had everywhere been removals to the asylums, and hence a diminution of the mortality outside these institutions: still, had no such emptying of the districts taken place, the death-rate would, nowhere, with the exception named (itself doubtless open to explanation), have exceeded the production-rate, and the total of lepers in the districts at the close of 1870 would in all probability have been quite as great as in 1856—or "in some places unquestionably greater." Elaborate tables are given, from which it appears that the yearly increment of new cases in a district regularly declines just according to the larger number of lepers removed to the asylums. Thus, *e. g.*, in Sogn district, whilst these increments proportionately to the numbers living at home remain the same in 1856—60, 1861—65, and 1866—70, yet by removal to asylums, the numbers at home being continuously reduced, there has occurred a concomitant reduction of new cases, as shown in the successive yearly sums of 89, 64 and 59; which still display a definite and fixed ratio to the immediately preceding totals of home-dwellers. No exception to the above rule has been found; and from close and rigid scrutiny of the data alone, it seems clear that the diminution of new cases in the districts goes *pari passu*, with the lessening number of home-dwelling sick: at least, amongst all the several data, no other relationship is so clear and variable as this one.

In his report for 1880, with matured statistics coming down to 1875, Dr. Hansen is not less emphatic; and finding a determinate ratio between the number of new cases and the immediately preceding number of home-dwelling lepers in a district (taking 5-yearly periods for each), he employs such ratio to make a forecast of the future progress of leprosy in Norway. The particular data adduced in support of these views are certainly remarkable and seem to me adequate; they are however,

too elaborate for reproduction here.* Once more, it is shown that in Norway the proportionate growth of leprosy is by no means diminishing; and hence an inference that the conditions for extension of the disease are in no way more unfavorable now than formerly. Since, therefore, the total of lepers is certainly lessening, this cannot be due to amendment (if any) in home-conditions; and the figures quoted are quite conclusive against the view that leprosy persists only as the result of ordinary mal-hygiene or a hurtful climate. In 1880, as previously, it is found that in the great majority of affected districts the death-rate of lepers lies below their increase-rate—the exceptions being one, or at most two, out of nine such districts; and as regards the other seven or eight, Dr. Hansen remarks the death-rate is so far below the production-rate (viz., from 2 to 6 per cent lower), that the condition of these localities would have been most grievous, had there not taken place a large emptying of the sick thence into the Asylums:—"Indeed, except in Nordfjord, everywhere would the actual production-rate have been greater than ever before, without such prior isolation as has been available, and incomplete as this is and always has been, we may congratulate ourselves that it was practicable, and ought to feel grateful to those who by their zealous labors for the public weal have effected the establishment of the existing Asylums" (p. 18).

Briefly, analysis of the official statistics proves that the affected districts are becoming emptied of their sick, not by excess of deaths but by abstraction and isolation in Asylums and at home of many affected persons. Dr. Hansen also very reasonably adds that on the supposition of leprosy spreading by contagion, one can readily understand the disease may be subsiding generally, in spite of a sustained production-rate; since, consequent on removal to the Asylums and on isolation at home there must necessarily remain at large a smaller number of contagion-bearers capable of infecting the hitherto sound. Indeed, except upon the hypothesis of contagion, no other explanation of events seems possible.

~~On the subject of the varying extent of disease, old and new, which prevails in individual areas, Dr. Hansen refers to the corresponding differences met with in abundance of the mild (smooth) and severe (nodular) forms of leprosy, showing in detail that where the worse form is commonest, there arise the largest proportion of new cases. Though somewhat recumbent, this explanation I regard as probably valid.~~

Summary of Part II.—The amendment of public health under notice cannot be satisfactorily accounted for by reference solely to a general improvement in diet, dwellings, soil or climate; nor has purely medical treatment ever proved curative; and so far from leprosy in Norway showing a natural tendency to subside, there is ample evidence of a present activity equal to that displayed by the disease 25 years ago. Some influence might, therefore, be assigned to the special measure of isolating lepers; and in point of fact, amongst all the available data, to none does amendment bear such definite relation—fixed or progressive—as it does to that lessening of lepers at liberty which results from the practice of enforced isolation. I admit that demon-

* Dr. Hansen's figures refer to separate districts to the total affected area. On analysis of column 3 (new cases) and column 7 (lepers at large) of the large table above, embracing the whole area, I find, after excluding the incomplete data of later years, that during the earlier years, 1856-70 inclusive, the annual ratio between new cases and sick home-dwellers is, in the main, very near 1 to 10. This implies the yearly advent of 1 new case to every 10 lepers at large; which is a ratio larger than the mean death-rate of such lepers. Precise figures for the three included quinquennial periods are successively as follows:—Mean annual number of lepers at large 2,871, of new cases 289; 1,994 and 204; 1,858 and 177. Subsequently to 1870 the ratio of new cases gradually declines; doubtless because their numbers have not yet been sufficiently ascertained. These data might have been introduced into the text of Part I, but they were reserved for this place as confirming the inference of Dr. Hansen, who does not (that I see) state his estimate to be the same as that here independently elicited. Whilst well aware that several conditions must intervene, I am still of opinion that here is evidence of a quite definite influence; and I agree with Dr. Hansen that the Norwegian statistics contain no more constant datum than this one, of a distinct proportion between lepers at large and the newly-made leprosy.

stration of such essential relationship is to be had only through a perfect acquaintance with every detailed instance adduced; yet with present information, I submit the evidence is enough to prove its reality, and to indicate the true *modus operandi* of leper-isolation as practised in Norway. More than a single beneficial influence may, indeed, be at work; but predominant is this exclusive dealing with the individual leper as himself the source of ill to others. So much being granted, it remains only to add that the transmission of personal ailment is necessarily effected either promptly by contagion, or slowly through communication to offspring—the intimate mode of transmission being essentially the same in either instance; and here Norwegian experience seems to indicate the usual predominance of contagion.

PART III.

PREVENTIVE MEASURES SUITABLE FOR INDIA.

Both social and humanitarian motives would inculcate the systematic relief of the leprous sick whose malady to themselves is so grievous and adding and to others so offensive or even hurtful. To all who recognise a claim thus founded the experience patiently and not uncostly accruing in Norway must appear equally interesting and encouraging. Being scientifically acquired, the principles hereby evolved become applicable under conditions so widely diverse as those of Norway and India. First, as to country and clime, there is no reason whatever to suspect that leprosy anywhere differs in origin or nature, any more than it differs in signs, course or consequence; and this consideration at once disposes of pre-conceivable objections to the best line of treatment being the same in both countries named. Analogy with other chronic diseases common to Europe and the East serve to confirm this view. Next, as to collateral circumstances, these are but subsidiary; only in India the people being subject, more ignorant, apathetic and prejudiced, it is for their leaders and the ruling powers to initiate the needful preventive measures, and to uphold these until by spread of knowledge and experience of good effected the public approval becomes assured.

General treatment of the leprous as a peculiarly affected class may be either ordinary or stringent. Thus, the sick may be collected and dealt with as ordinary hospital patients; without, that is, regard to prevention or future amendments. Or, for permanent relief, they should be strictly isolated from the rest of the community, and amongst themselves the sexes kept apart—isolation of this kind being practicable at the homes of lepers, but better carried out in Asylums. Evidently, this last method is the only one likely to check and lessen disease; it has, in Norway, proved to be beneficial in both these directions, as well as by awakening the people to a sense of rational self-help and a willingness to co-operate further. Such a cogent and attractive stimulus is much needed in India, where the foundations of public hygiene have yet to be laid.

Segregation is practicable in three modes, either separately or combined:—

1. By erecting plain Asylums at certain centres, each of which would be a refuge common to several districts; and a place of detention, under due management and supervision.
2. By founding Leper Colonies or village communities mainly of the affected, who, while allowed more liberty of movement, should yet be prevented from mingling with the peasantry around: hence still the need of strict supervision. Many spots would thus serve—such as deserted forts, decayed villages, and places now waste yet not far from other sources of supply, or not without near resources easily resuscitated.

3. By requiring the strict isolation of leprosy subjects retained in their homes at express wish of friends. Suitable separate lodgment would be indispensable; unsuitable shelter is even now sometimes supplied. Joining of such home-isolation with more public measures should not be overlooked; for to its experience in Norway seems to point as a means essential to complete success within a moderate period of time; and in India it would have to be still more largely resorted to.

For carrying out the above, in addition to funds, legislative authority is needed to take up the vagrant sick, to remove the sorely diseased who is insufficiently guarded at home, and at times to enforce continued isolation of the infected until medical sanction of liberty be granted. Such authoritative interference will, I am aware, be differently regarded by many and disliked by the masses; yet it cannot at present be dispensed with, and sufficient precedent exists in several British enactments against small-pox and contagious diseases of men and animals. Besides, as analogues, special institutions already exist for the permanently disabled, the blind and the insane; also, in most civilised countries, for those incurably affected with cancer and consumption. At one time, indeed, Asylums for lepers were common all over Europe, where now the disease generally has become eradicated; whilst Norway still presents a number of these peculiar establishments adapted to modern requirements, and, as I have tried to show, not less than formerly of decided efficacy.

Note on the Pathology of Leprosy.—I have long regarded this malady as one of the great chronic infective diseases of the human race; and such view I hold to be confirmed by Hansen's discovery that in leprosy structures there is always to be found an algal growth—a *bacterium*, which is absent from both healthy and differently diseased structures. In its fresh state I once saw this organism at Bergen (1875), and soon after at Bombay; and quite recently it has been repeatedly studied on the Continent of Europe. With the aid of new re-agents its presence is easily demonstrated; and I offer the appended illustration as an original one, corresponding closely with descriptions given of European specimens. In June last I excised a small nodule from the arm of a leper; and after immediate hardening in alcohol made sections for double staining after Ehrlich's method. All these fragments show crowds of bacilli and several large collections of granules (? spores), which when unstained no doubt correspond to the "brown cells" figured as characteristic in Plate XII of my large work on Leprosy (London, 1874); besides, there are seen cells and nuclei belonging to the common tissues of the nodule: see FIG. 1. Here the patient was in fair health, the cutaneous eruption of several months standing, and quiescent or slowly subsiding. The minute organisms could not possibly have been accidentally introduced; their number is immense, and they seem to be growing actively, the products, doubtless, being eventually absorbed. As contrasted with the violent symptoms attending pathogenetic bacteria of acute infections, the little irritation, local or general, commonly attending *bacillus leprosy* is remarkable; yet occasional exacerbations of disease do occur, during which there is fever and wide reproduction of the nodules; and thus the general analogy of leprosy to syphilis and tuberculosis becomes apparent. European observers have found both bacilli and spores in lymphatic glands and the blood; also in diseased nerve-trunks, liver, spleen and testes: the evidence of systemic infection being then complete. It is known that the organism will grow outside the body, and there is evidence that its germs (like those of tubercle) are freely given off from the persons of lepers; and by comparative experiment it is further ascertained that although general disease fail to appear, yet leprosy material inoculated in animals slowly leads to a real—if imperfect—local reproduction of the leprosy processes taking place in man. As systemic infection with a visible eruption occurs only at prolonged and irregular intervals in him, in the lower animals (themselves possibly less fit subjects) these intervals may be so long as to require a year, or more, for such outward manifestation. At present, proof of the contagiousness of leprosy is mainly inferential; but further experiments may furnish positive data, like those now being acquired in the instance of tuberculosis, which so nearly resembles leprosy (vide large Work, p. 176). This similitude holds good not only in a general clinical sense, but also as regards the attendant parasitic organism; and, in evidence, I have drawn some figures of the *bacillus tuberculosis* on the same scale as those of the leprosy growths: see PLATE, FIG. 2. This second

specimen was taken from the lung of a consumptive patient, who died in the J. J. Hospital: similar appearances have been seen in the sputa of other phthisical patients, and they correspond to English descriptions. The *b. leproe* I find to be usually shorter and more variable in dimensions—length $\frac{1}{1000}$ to $\frac{1}{500}$ in.; less bent, oftener bulging in centre and thinning at the ends; oftener dotted in aspect or composed of distinct granules in linear series, the number and site of which differ considerably. The amount of small rods and signs of spore-production greatly exceed what has been seen in tuberculated tissues; yet the general characters and processes appear much alike in both sets of specimens. Other particular features are shown in the drawings, made as accurately as possible with the aid of a $\frac{1}{2}$ in. water-immersion lens, eye-piece B, and achromatic condenser of Swift.

(Signed) H. V. CARTER, M. D. (Lond.)

Bombay, November 1883.

"Further observation on the Prevention of Leprosy by segregation of the affected."

(For preceding Articles see the *Bombay Government Gazette* of 6th March 1884, Part III.)

"Having, in anticipation of the next quinquennial report, received from Bergen a short summary of the latest results of the segregation of lepers as carried out under the Norwegian Government, I think it not inopportune, with reference to recently awakened public interest concerning leprosy in India and elsewhere, to submit the following information. Dr. G. A. Hansen's position as Director of the Norse Leper Department serves for ample guarantee of the authenticity and accuracy of the statistics subjoined; and my friend of 1872 has added to his obliging communication some data of collateral interest bearing on the etiology of this national pest."

"First, as to the progressive decline of leprosy in Norway, my previous India Office Reports and the Bombay Memorandum of 1884 will be found to contain all the needful evidence establishing the fact that the total number of lepers officially registered had, between the years 1856 and 1880 inclusive, diminished from 2,863 to 1,382—see, for example, column 9 of the table given in the local Gazette. Of that later total, 617 were lodged in the Government Asylum, and 965 were living at their homes."

"The three chief asylums are recruited from the country districts under conditions already detailed; and the number of lepers they lodge at present is, I learn, 'about 500.' Owing it is understood to economic measures, the asylum population has of late years been somewhat reduced: otherwise, had the previous annual mean of about 650 (for the decennium 1871-1880) been equally maintained until now, this sum would exactly equal the total of lepers at large, as shown below; and so would have been realised the sanguine hope expressed five years ago in the words 'by the year 1885 it is anticipated that 50 per cent. or one-half the entire leper community will be isolated'—see my preceding Article, page 3, heading C, column 7. A detailed statement of the incarcerated sufferers for the quinquennium 1881-1885 is promised so soon as the official reports are complete; and since the greatest pains are taken to reach accuracy of every detail, some time longer may elapse before they are issued: meantime, the above comment may be regarded as noteworthy by way of both encouragement and warning."

"As regards 'home-dwelling' lepers—hygienically, perhaps, the more interesting and important section to notice—Dr. Hansen has furnished me in advance with the following datum, which concisely shows the diminution outside the asylums that has of late and is still going on, as he remarks, 'steadily and tolerably fast'."